



American Crow on a street light about 100 meters from its nest in a Bur Oak in a cemetery – Winnipeg

Men asked each other, what did the crow say about the flight of birds in a high wind? What did it say about salamanders? They wished the crow hadn't left them: they wanted to ask all the questions they'd neglected to ask while the crow was in their midst. And even while the crow had been talking, meditative and wise, they'd neglected to listen, they realized. Now and then someone claimed to quote the black crow on the subject of women and guns.

– Robert Kroetsch 1978 17k

At Luther Marsh I paddle steadily to reach Prairie Island. On this low oval dish, paintbrush, goldenrod and Wilson's Phalarope greet me. With a slender, multi-colored head and neck bobbing at each call, a phalarope flutters two meters overhead. I am transformed. There is nothing in my language to describe what I am hearing. It is the most unmechanical avian sound I have ever heard. The muted vibrations enter and flow through me like a narcotic. Alone on the island, I pause and listen.

A crow calling at dawn is the call I know and like the best. I do not tire of a bout of three caws. James Russell Lowell felt its power – “Yet there are few things more melodious than his caw of a clear winter morning as it drops to you filtered through five hundred fathoms of crisp blue air.”

On 12 January 1855, Thoreau entered in his journal –

It mingles with the slight murmur of the village, the sound of children at play, as one stream empties gently into another, and the wild and tame are one. What a delicious sound! It is not merely crow calling crow, for it speaks to me to. I am part of one great creature with him; if he has voice, I have ears ^{t45}.

What we hear

Dr Walter P Taylor told of a singing crow perched in a tree. “One would never suspect that such tender notes could come from the raucous throat of a crow” g75.

Perched atop a pole, a crow is calling. Its neck is stretched and throat feathers are spread, giving a show of gray. A loud sharp caw is made as the head is raised and wings pumped at the



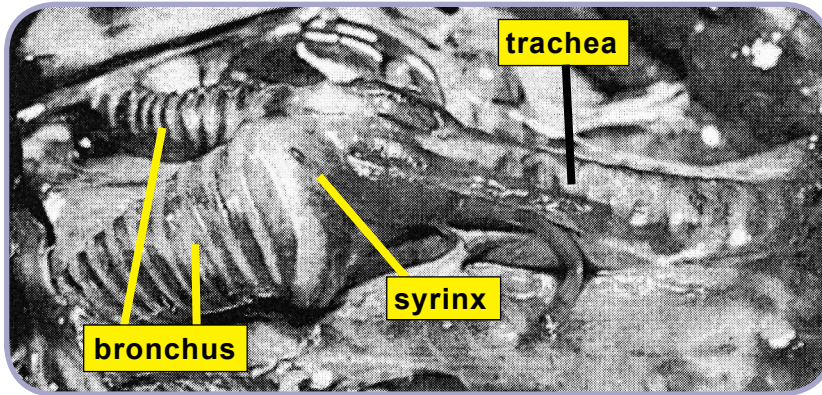
A blackshirt in **Winnipeg** calling from atop a telephone pole; the mouth is black

sides. It is throwing the sound out and away from its body. A bout of caws carries well in the open.

SW Rhoads, in the late 1800s –

The monosyllabic speech of a crow is by most accounts to be little more than a monoverbic “caw,” but let such as thus regard it visit a crow roost and attempt to classify the sounds there produced and, if his ear be well set to music, he'll have





American Crow Lateral view of syrinx at the base of the trachea c50,
© American Ornithologists' Union

made two caws.

A couple of definitions
from AS Gaunt –

“**Vocabulary** is the set of sounds and modulations a bird can make. Essentially any sound recognizable as a specific figure in a sonogram is an element of a vocabulary. A **song** is a repeated pattern of vocabulary elements (= phrase, song or song types of others)” g10.

a long list.

Among birds so eminently gregarious, language naturally becomes an ever-abiding necessity. A crow is as great a conversationalist as is the nightingale a great singer; this one, out of the heart's abundance, voices his music from a pure love of harmony; that one, out of the abundance of his wisdom, speaketh; this is the sapphic humming of a tune; the other, a terse, laconic sentence made up of one word, yet calculated by its variety of modulation or of emphasis to convey a variety of ideas. On every occasion of my visits to those places the strange sounds uttered by those crows already gathered in the dormitory were a continual surprise. Were it possible to reproduce such sounds before a body of ornithologists, nine-tenths of them would have no thought of assigning them to the vocabulary of any North American bird r49.

“Dr. Caffrey has noted that Eastern and Western crows have different accents. There is a crow on just about every movie sound track, and she can tell whether the movie was shot in the East or the West by how the crow sounds” 78b.

Some asked whether the crow's call was a caw or an aw. When a recording was played at slow speed, a group of musicians could not identify a C sound at the front of the caw f71. Even so, most crow-watchers still prefer a cawing crow, which is a pleasant sounding phrase. Regardless of how it sounds, the bird can call with a full bill. In early April, a crow with a 30 cm long twig in its bill, cawed four times while perched. On another occasion, a crow flying with food visible in its bill

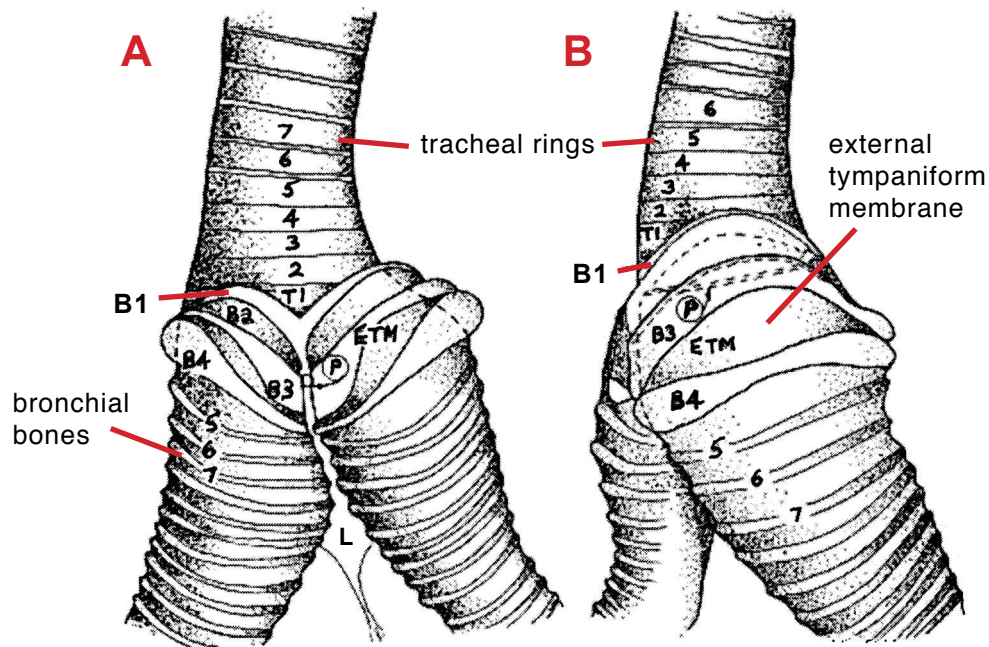
Anatomy

Text and images will help to understand the vocal process. Inside the bill, behind the base of the non-fleshy, **naturally split tongue** is the slit of the glottis. In this area of the larynx are eight separate skeletal parts and four sets of muscles, two of which control the glottis opening. In birds, the voice box is the internal syrinx, and it is located at the base of the trachea where it bisects into the bronchial tubes. During exhalation, air passes from the lungs (air sacs) through the bronchi past the syrinx, along the windpipe (trachea) and through the glottis opening of the larynx to the outside 32b.

Researchers in the 1950s showed the syrinx had six pairs of muscles and an auxiliary membrane that controlled a crow's voice box. In comparison, seven pairs of muscles were present in the Gray Catbird, House Wren and Tufted Titmouse 28m. A later consideration in the 1960s was based on 55 American Crows collected in the fall and winter near Blacksburg **Virginia**. Again, upon dissection six pairs of muscles were associated with sound production. These muscles, with their probable function –

- (1) Bronchialis anticus medialis – tenses the external tympaniform membrane
- (2) Bronchialis anticus – draws the posterior margin of B3 outward and forward. B3 has a large ventromedial cartilage that turns the internal tympaniform membrane close to the external





161. American Crow Bones and cartilage of the syringeal area. **A** – ventral view; **B** – lateral view. T1–T7 tracheal rings (bone); B1–B24 bronchial bones; B5–B7 bronchial rings (cartilage); P pessulus bone (connects the dorsal and ventral extremities of the first pair of bronchial bones); ETM – external tympaniform membrane; L interbronchial ligament c50, © American Ornithologists' Union

tympaniform membrane

- (3) Bronchialis anticus lateralis – relaxes the external tympaniform membrane and pulls it away from the internal tympaniform membrane
- (4) Bronchialis posticus – tenses the external tympaniform membrane dorsally
- (5) Bronchotrachealis posticus – turns the anterior margin of B4 medially up to 80° on its longitudinal axis to push the external tympaniform membrane medially
- (6) Sternotrachealis – steadies the syrinx
- (7) Auxiliary membrane – not a muscle, it steadies the external tympaniform membrane and helps to uniformly adjust the pitch

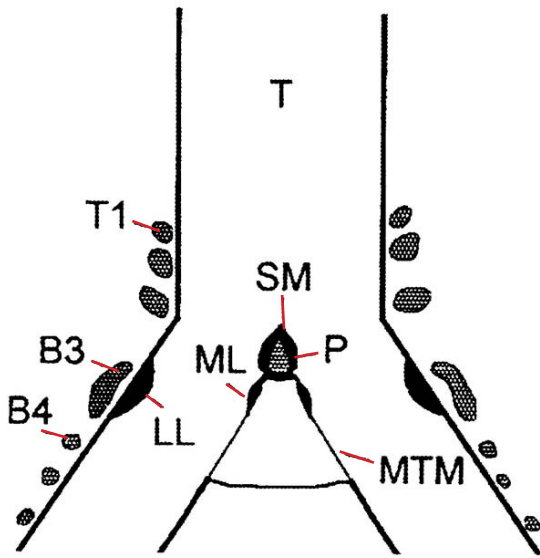
The six pairs of muscles in the syrinx produce sound by “adjusting the distance between the external and internal tympaniform membranes and by adjusting the tension on the external tympaniform membranes.” The lower 3–6 rings of the trachea enlarge to form the tympanum. Below, the first three crescent-shaped rings of each bronchus are also enlarged to complete the bron-

chotracheal syrinx. These modified rings “are ossified and contain hematopoietic bone marrow.” As air rushes forward, this draws the external and internal tympaniform membranes together which causes the pair of external tympaniform membranes to vibrate and make a caw sound. When the external tympaniform membrane is stretched, the sound increases in pitch due to its increased tension c50.

Although some of my readers would not describe the call of a crow as musical, they might be surprised to learn the America Robin has only five pair of syringeal muscles, and the House Sparrow four pair. One study pointed to a direct relationship between a higher number of paired voice box muscles and an increased degree of refinement in the nature of the song of passerines, such as the crow 28m. The Jungle Crow, *Corvus macrorhynchos*, an Asian bird, has 7 pairs of syringeal muscles t77. However, it should be noted that “vocal plasticity is not absolutely linked to the number of intrinsic muscles.” 910

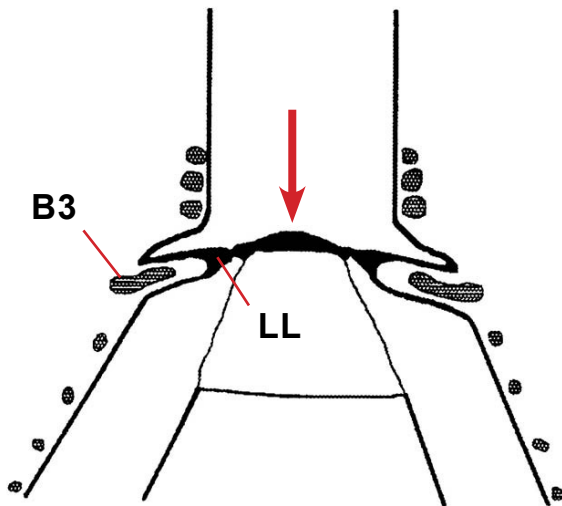
One hypothesis – a large vocabulary or the



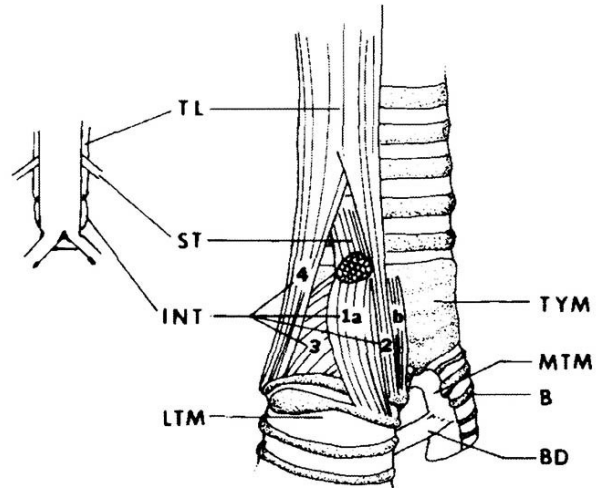


162. Configuration of the syrinx during quiet breathing in a frontal schematic section g32, © National Academy of Sciences, USA

B3 – third bronchial ring
LL – lateral labium
ML – medial labium
MTM – medial tympaniform membrane
P – pessulus (not ossified in the crow)
SM – semilunar membrane
T – trachea
T1 – first tracheal ring



162a. The dome-shaped phonatory position of the crow's syrinx lacking an ossified pessulus g32, © National Academy of Sciences, USA

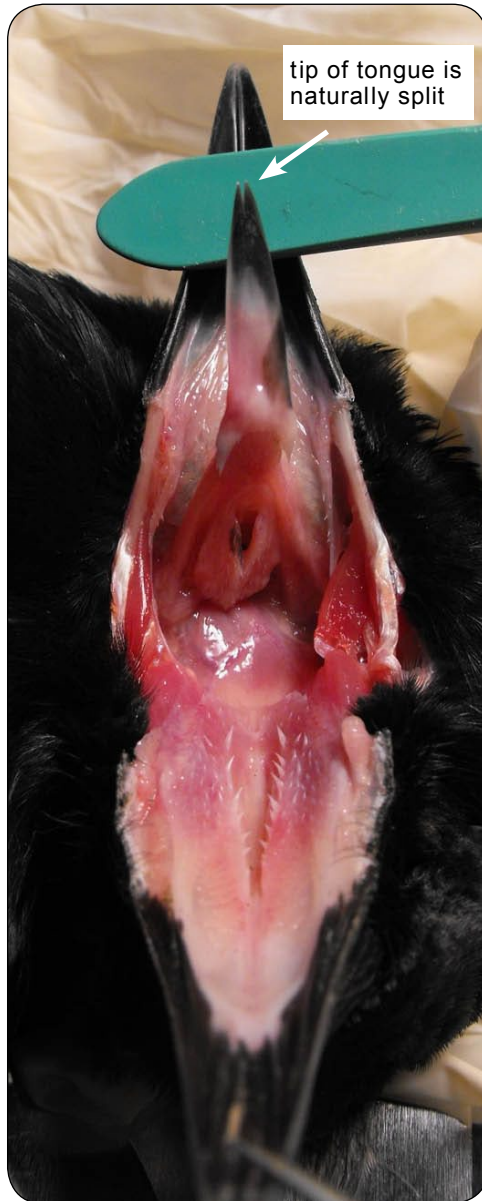


162b. Frontal section and lateral view of an idealized, oscine syrinx. Muscles of the left side are not shown. The presumed intrinsic muscles have been numbered. Many authors consider 1a and b separate muscles, but they seem to be portions of a single mass of tissue. Similarly, 2 and 4 are universally considered as intrinsic muscles, but do seem to be direct extensions of TL. **B** – bronchial bar; **BD** – bronchidesmus; **TYM** – tympanum g10, © American Ornithologists' Union

ability to learn sounds may not be correlated with the complexity of the syrinx in birds. "The isolation of the flexible portions and the specialization of muscular function permit an extremely fine control of the oscine syrinx. That control does not enable oscines to produce new kinds of sounds, but it does simplify the conversion from one to another. Here a proliferation of components has simplified control, and with that simplification vocal plasticity and large repertoires become practical" g10.

An alternative sound source has been suggested. Under the old ideas "Sound production is commonly believed to involve a constriction of the bronchial lumen by the lateral labium, which, when combined with high subsyringeal air sac pressure and increased air velocity, induces vibrations of the medial tympaniform membranes (MTM) by Bernoulli forces and pressure differences." Instead, they surgically disabled the MTM and filmed the syrinx *in situ* through an angioscope during sound production. A Rock Dove, a non-songbird, provided the syrinx control. A hand-raised female American Crow provided sponta-





American Crow The tip of its tongue is naturally split for 1–2 mm. Some crows learn to talk; some don't. Inside of a dead juvenile (6 months of age) male's mouth showing the pink and black pattern that becomes all black with age and status

neous calls and wild male Northern Cardinals, Brown Thrashers, *Toxostoma rufum*, and Zebra Finches, *Taeniopygia guttata*, made sounds due to brain-stimulation. The MTM was fully ruptured on both sides and withdrawn leaving a hole that was covered by the membrane. After this surgery, the finches' and cardinals' calls and songs were intact although at a lower intensity. Clearly, the

medial tympaniform membranes were not needed for vocalization.

In the crow, "the semilunar membrane moves in concert with the labia due to the absence of an ossified pessulus (a wedge-shaped cartilage in the syrinx of a bird, lying at the bifurcation of the trachea and dividing it into the two bronchi) and lack of structural support." As sound is produced the labial folds vibrate at a low amplitude (the maximum extent of a vibration measured from the position of equilibrium). "During high-intensity (sound power per unit area) calls in the crow, the labia of both sides of the syrinx and the semilunar membrane form a dome projecting craniad [toward the head] into the trachea."

During sound production, the syrinx is re-configured causing the "closure of the bronchial aperture by approximation of the medial labium and lateral labia, with at least partial apposition along the dorso-ventral axis" 932.

Their language

"The use of ordinary cawing by crows presents an interesting challenge to the traditional view of crow communication. Two different crows, sitting perched in the same tree and subject, presumably, to the same circumstances, often give radically different patterns of ordinary cawing. The same crow, as he moves from tree to tree, from preening to feeding, from solitude to joining a group, often persists in giving a particular pattern of ordinary cawing. On the other hand, such a single crow may dramatically and without warning alter his ordinary cawing pattern to a pattern different in pitch and temporal organization from the pattern in which he has been persisting. Such shifts may occur in response to no discernible social or environmental circumstance. Nor need they be accompanied by a discernible reaction in crows within hearing. Thus, the use of ordinary cawing appears to violate the 'tradition' that each different caw in a crow's repertoire has a particular meaning, occurs in a particular context, and is responded to by a particular limited set of behaviors on the part of other crows" r51.

Let me begin to describe their language with a simple arrangement. Three clear caws in a row can be given in about 1.5 seconds. I and others





label this a three-caw bout. Some have used the term “burst” instead of bout. Burst, however, seems a little too forceful a description for a daily, normal activity. I am discussing speech, not dams or bombs. After a three-caw bout, a crow often pauses for several or more seconds before giving another bout of caws. Over a few minutes, a string of 5–30 bouts is called a sequence. A sequence of nine bouts can be represent as: 12–2–7–4–4–3–5–6–8, which contains a total of 51 caws. Another sequence of nine bouts may have a repetitiveness: 3–3–3–3–3–3–2–3–3 which contains 26 caws. FH Allen thought the “crow takes delight in the rhythm and variety of his utterances” a15.

Structure and unstructured calling

The structure of a sequence of caws might alter the meaning other crows get from the sequence. Moreover, caws on their own do not have a “different stable meaning” until they are united into bouts and these into temporary sequences r51. Those who study the crow’s vocabulary group caws according to whether they sound structured (ordinary), or unstructured. In structured calling, caws are given in regular, ordered bouts throughout a sequence. Structured caws can be used to identify calling crows. It was suggested each bird “will emit sequences with distinctive physical, temporal, and numerical properties.” The idiosyncrasies of each bird’s call are recognizable t41.

Unstructured calling is generally associated with an increase in excitement. Caws are given in long irregular bouts, and crows usually sound quite similar due to a high emotional involvement. It is usually easier to provide a reason for unstructured calls t41. The shift from structured to unstructured calling is usually sudden (when a predatory hawk appears), but the return to structured, ordinary caws is more gradual as the excitement slowly wanes.

When we reflect briefly on our own language, speech serves to identify and locate us, express feelings and relate ideas. Crows are vocal, social creatures. Their language, if at all congruent with ours, must serve them in comparable ways to meet their needs. Thus far, however, their messages of caws (syllables), bouts (words) and sequences (sentences) are comprehensible only



An American Crow doesn’t need an e-device to communicate its intentions and thoughts. Our plastic devices break, become outdated, or are lost. A crow’s syrinx lasts a lifetime

to them – which is good.

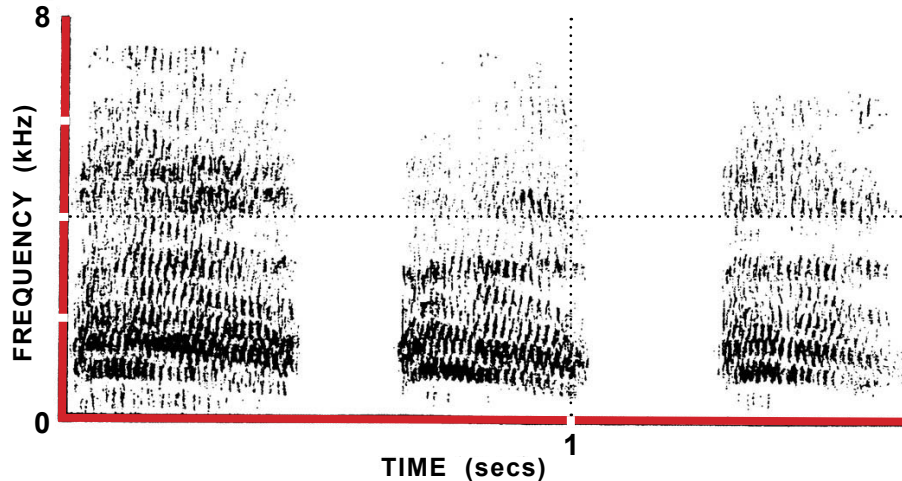
Assembly / mobbing calls

Listening to crows talk in caws (and not other sounds), it was apparent a single caw varied in clarity and duration. Taped natural caws were altered by changing the temporal properties to determine how crows responded to a manufactured assembly call from natural, non-assembly calls. The assembly call is a series of low, harsh sounds which are variable in pitch and timing. Crows will

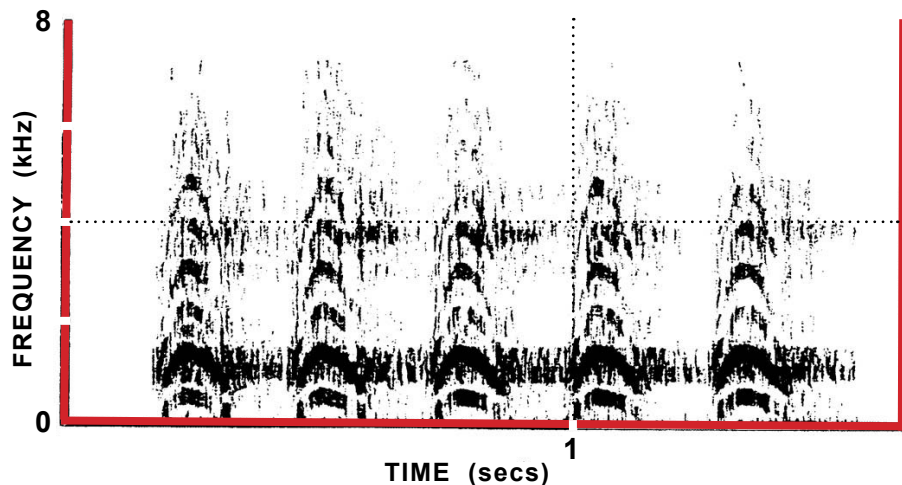


164. American Crow Sonogram image of two high-pitched caws r51, © Brill





165. A segment of grainy ordinary cawing (about 2 / sec) r51, © Brill



165a. A segment of high-pitched ordinary cawing (about 3 / sec) r51, © Brill

fly toward a recorded source of a natural assembly call about 25% of the time.

It appears, within the parameters of this experiment, “not all types of crow sounds can be manufactured into effective assembly calls.” –

(1) a high-pitched call arranged to match as closely as possible the temporal properties of an assembly call did not cause crows to assemble nearly as often as the real call

(2) some calls, which have the harsh, grainy quality, can be rearranged into an assembly call that sometimes works better than the real call, if the right temporal pattern is employed

This indicates a caw may not have a fixed meaning to other crows. Instead, the experiments suggested the “meaning of a sequence of crow sounds is thought to depend not only on the properties of the caws but upon the temporal properties of the sequence as well” r51. One possibility, I suggest, the crows responded to the second manufactured assembly call partly out of curiosity.

The mobbing calls of the crow lasted about 1.8 seconds and contained frequencies from 1.22–3.81 kHz ^{f25}. In Ithaca **New York**, the mobbing call of the crow was studied to determine what it may tell incoming crows about the preda-





When an adult American Crow caws, the blackness of the mouth is revealed

tor type or level of danger. Using two predators, a model owl and a raccoon, they found crows emitted the same types of calls in response to the two types of predators. Regarding the level of danger, they suggested caws with a longer duration, shorter interval between caws and a higher rate of calling indicated a greater danger. There were differences in the call structure in the trials that may indicate individualized or group variations in vocalizations about predators ^{y18}.

Alarm / dispersal calls

The inflected nature of the crow's alarm call was run through special software. Alarm caws of 15 marked, wild crows were measured within a couple of months after the young fledged. Eventually, variables in the calls were reduced to 7 meaningful ones, which explained 90% of the variation for all crows. This meant crows may have the ability to identify each other by the structure of the alarm call. Additionally, five of the seven features were sex related due mainly to the caw's frequency. One subordinate male's call was aligned with the

females'. Individual alarm calls may have adaptive social significance within and beyond the family group depending on which crow was calling, with how much urgency, and which crows were responding ^{y17}.

A pair of golden orioles
Sings in the bright green willows.
A line of white egrets crosses
The clear blue sky.

– Tu Fu ^{r47}

3 and counting

For two years I counted the bouts of structured and unstructured caws in all seasons, including the single caws of juvenile crows, and the symphony of caws at wintery roosts. Some patterns emerged, testifying to the vocal organization of this bird's communication network.

The regular three-caw bout (represented by – – –) was heard most often. One variation of the regular bout was altered to (– – –) by lengthening the second inter-caw space. Another was two long caws, the carr-carr note in a bout that lasted about 1.5 seconds ^{c52}. Their meanings are unknown.

■ came to realize, as did NS Thompson, that three caws made up the most commonly produced bout in each month and over a year ^{t36}. Of less parity were bouts of 1–6 caws.

■ Bouts of more than six caws were not frequent. As mentioned, longer bouts of unstructured caws were associated with our notion of expressions of threat, anger, alarm or excitement by the crows. Deliberating on the numerical aspects of bouts and sequences of caws, Thompson presented the idea of a link between the counting ability of corvidae and their vocal expression, with the higher limit near six ^{t36}. From my work, bouts of 1–6 caws made up 91% of the bird's vocabulary. A one caw bout was common in June and July, chiefly from the abundant begging for food by juveniles, and less so in April from the female adult crow begging from her nest. These





latter one-caw bouts amounted to only a couple of percentage points of an adult crow's calling. More than three caws per bout showed a steady decline in number. The longest number of caws in a bout was 39, at a roost, heard only once in two years.

167. Three caws in a bout was the most commonly heard number by the American Crow in southern **Ontario**

Caws per bout	Number of bouts	% of total 16,633
1	1379	8%
2	2670	16%
3	4271	26%
4	3654	22%
5	2010	12%
6	1223	7%
Total		91%
7	553	3%
8	281	2%
9	162	1%
10	108	1%
Total	16,311	98%

A comparison was made of the calling patterns of the American Crow in the **United States** and the Carrion Crow of **Europe**. The caws of both species had similarities and were often given in structured bouts. Measurable differences showed Carrion Crows gave fewer caws per bout (about one less caw on average), their caws were longer, and the inter-caw interval in each bout was also longer than those of the American Crow's. It was suggested structured caws may be distinctive for an individual crow by the slight variations in the pattern of caws it gives t41.

I have heard the American Crow give a distinctive 2-syllable call, a broken caw if you like, which I represent by a "V". This caw can exist absolutely in bouts on its own. A bout of seven was the maximum I recorded. When a crow produced

only V caws, 3V was again the most commonly given bout. A mixture of regular and broken caws is possible as the following sequence of bouts demonstrates: 7-6-5-5-3v-5-3-6-2v-5-5. The 2-syllable caw was also given in all combinations of bouts with a regular sounding caw. I've heard 2-syllable caws during territorial disputes, as the first call in the morning, and several times during the day. I have no idea what it signifies.





American Crow calling from a spruce tree

168. American Crow Three or two caws in a bout including the 2-syllable caw (V) alone, and in combination with a regular caw (-) were given most often in southern **Ontario**

Bout	#	Bout	#
V *	28	V- **	72
2V	187	V--	32
3V	199	V---	36
4V	73	V----	17
5V	17	V-----	5
6V	5	V-----	4
7V	1	V-----	1
		V-----	1
		V-----	1
		V-- --	4
		V-- ---	2
		V--- ----	1
Bout	#	Bout	#
V-V	66	-V	5
VV-	28	--V	1
V--V	24	-V-	1
V--V-	1	-VV	3

V--V--	1	-V-V	4
VVV-	1	-V-V-	2
V-V-V	9	-V-V-V	1
V-V-V-	3		
V--VV	1		

* V is the 2-syllable caw

** V- is the 2-syllable and a regular caw (-)

168a. There are auditory differences in the acoustical relationships among some typical calls for the American Crow (AMCR), Fish Crow (FICR) and the Common Raven (CORA). Between the male and female American Crow, his caws are deeper sounding. The calls of the Common Raven are deeper yet d21

Species	Fundamental Frequency cycles / sec	Pitch
AMCR – female	752	1504
– male	638	1276
FICR	281	1390
CORA	56	975

Clear recordings (596) from 10 species of birds, including the American Crow in Winnipeg **Manitoba**, were subjected to software analysis. One bird of each species was recorded, and after extracting the spectral and cepstral parameters, a computer was programmed to determine which species it might be hearing. Applications could involve its use in bird to plane strikes, night-flight monitoring, and wind turbine research. Using the NN-20 system, the American Crow had the highest call accuracy at 99% versus an average of 76% for the 10 species of birds. The crow's frame accuracy was 95% versus an average of 67% for the 10 species. In conclusion, "calls can be recognized based on short-term features." Support Vector Machines (SVM) slightly outperformed Artificial Neural Networks (ANN). But KDE (voice recognition software) and NN-20 had similar performances 24r.





But what do birds actually hear? The maximum frequency a species can hear tends to be correlated with the average range of frequencies of its own song. The minimum frequency heard was far below the lowest frequency a bird can make. Not surprisingly, “songbirds can hear most of the frequencies in their vocalizations” 06k.

Soothsayers in India, followed by the Chinese and Tibetans, chartered 90 different interpretations of the crow’s caw according to its time, nature and direction 1b4. An exceptional ornithologist, Cyril Harrold interpreted 15 different calls of the American Crow, including one that signalled the presence of a Peregrine Falcon c37.

23 types of calls

The calls listed below leave much to be desired, both in their names and descriptions of what the calls sound like. However, it is an improvement over how a call at a crow roost in the late 1880s was described using a cultural context r49.

In early-morning conversations on the roost we can hear the greatest variety of notes. One of the most notable of these resembles laughing in its hilarity of tone, and sounds something like gärrick or clä-ä-ä-ä-ärrick by trilling the a’s and r’s at a high, feminine pitch of voice. It has kinship to the familiar ejaculation of a strawberry woman in the city street.

In the *Birds of North America* series for the American Crow, (647), 23 different calls are described with text. Similar calls, described by other authors, are sometimes included. Eventually, the names will have to be sorted and standardized to be useful to future crow-watchers. Some calls are playable online, and if you have purchased Michael Westerfield’s book, *The Language of Crows*, a clear, useful CD is attached to get you started.

The 23 calls –

(1) **Short Caw** A general alarm

call for territorial intruders; a caw lasts 152 milliseconds (ms) p15

(2) **Short-medium Caw** No function; each caw averages 250 ms in duration p15

(3) **Medium Caw** Territorial advertisement; each caw averages 345 ms p15

(4) **Long Caw** No function; a caw averages 469 ms p15

(5) **Harsh Caw** Predator mobbing; each caw averages 315 ms p15

(6) **Ko-aw** Threaten intruders, crows arrive from other territories; each caw averages 235 ms p15

(7) **Ko** Predator alarm; each caw averages 162 ms p15

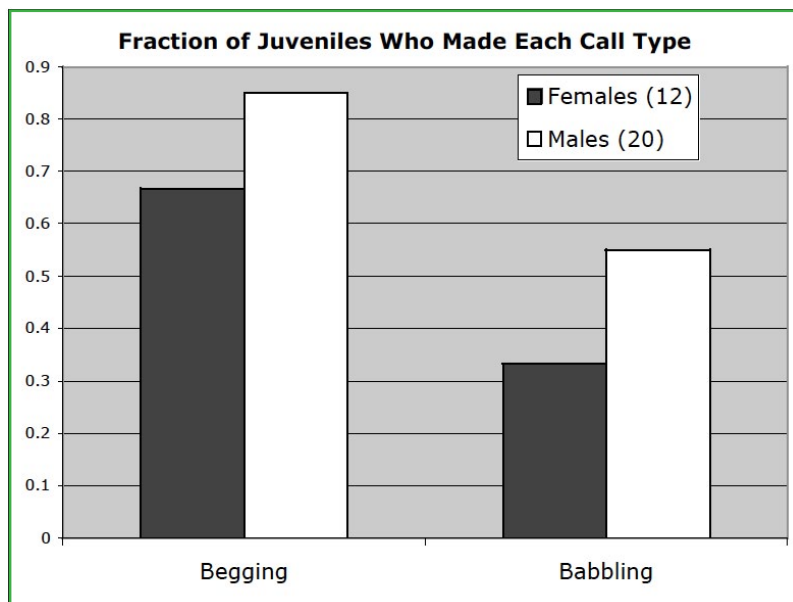
(8) **Long-medium Caw & Medium-short Caw** Used in countercawing sessions 93b

(9) **Double Short Caw** Countercawing at beginning of bouts of chasing over territory; a call to arms for the family members p15

(10) **Assembly Call** A raucous, intense mobbing call to alert others about a predator; each caw lasts 500–700 ms with 120–160 ms between the caws 93b

(11) **Mixed Caw** A call related to a predator’s movement; a caw lasts 150–550 ms with a sequence lasting 3–15 secs for 4–20 caws 93b

(12) **Inflected Alarm Call** A call of short bursts related to predators; each caw lasts 100–150 ms



169. American Crow Juvenile males gave slightly more calls in both categories t07, © Ohio State University





with intervals of 325–555 ms between caws ^{93b}

(13) Alert Call A continuous sharply staccato mobbing call to warn crows ^{c52}

(14) Dispersal Call Warns crows to leave an area. Very similar to the alarm call but with sharper notes in a very short space of time

(15) Modified Scolding Call All notes inflected (pitch changed), given when predators are seen

(16) Long Call Inflected at the onset; each caw lasts about 450 ms with an intercaw interval of 250 ms; usually 2 or 3 caws in a bout; associated with distant danger or general daily communication ^{93b}

(17) Squalling Call A crow struggling to escape a predator's grasp gives wailing high-pitched sounds which attract crows ^{c52}

(18) Rattle Short, 5–20 staccato notes in one sequence when perched; resembles the sound of woodpeckers tapping wood

(19) Announcement Call Given to let nestlings know an adult is approaching with food ^{k63}

(20) Food-begging Call A repeated loud begging caw from an incubating female that wants to be fed by her mate; heard up to about 300 meters away; sounds like an older juvenile begging for food from a parent ^{k63}

(21) Dive-attack Call A rattle when rapidly descending in play, attacking predators, and over the roost, etc ^{v18}

(22) Song A mixture of many non-caw notes (some very softly) with an “improvised rambling quality;” generally not heard by the public, or if heard, not attributed to a crow ^{94b}. Given softly with up to 60 elements per minute and lasting for almost 40 minutes ^{g75, k63}

(23) Mimicry Calls sounding like other animals

or people. Rural crows yodel in Florida ^{v18}

NOTE – The length of caws listed above ranges from 100–777 ms.

Location of some calls

Some calls are more likely to be given in certain areas of the territory, ie. the long-medium caw was given more often near the center of the territory than one would expect by chance, while the Ko-aw series was often given from the edge of the territory. Some caws were directed beyond the territory, while others were useful within a territory ^{p15}. Crows gave a short bill-clacking, percussive single sound ^{k63}. Perhaps the same clacking sound was given by caged crows showing short bouts of aggression ^{p15}.

Several other soft, subtle calls are also given by the crow, but seldom heard or reported. Two calls in **Florida** were from female American Crows early in the nesting season – the shudder call and the nest call were loud calls given by the female as she wove a twig, often with difficulty, into her nest ^{k60}. Several calls were recorded at close range by Lawrence Kilham from semi-tame, but free-ranging unmarked crows in **Florida**. Most are available as sonograms from the Florida State Museum Bioacoustic Archives in Gainesville ^{k59}.

Kilham described several more calls –

(1) G-wal-op and g-wal-ops were delivered as a doublet heard throughout a territory. Given mainly by the breeding male at the start of the nesting season. Yearlings may give dozens of these calls in the early spring, as if practicing. Other loud



Atop a street light gives a great view and a place from which to contact family members





doublets included – G-wong, G wongs; kwar-uck, kwar-ucks; guelph, guelphs; and kuk, kuks. Some were given by yearlings and one breeding female.

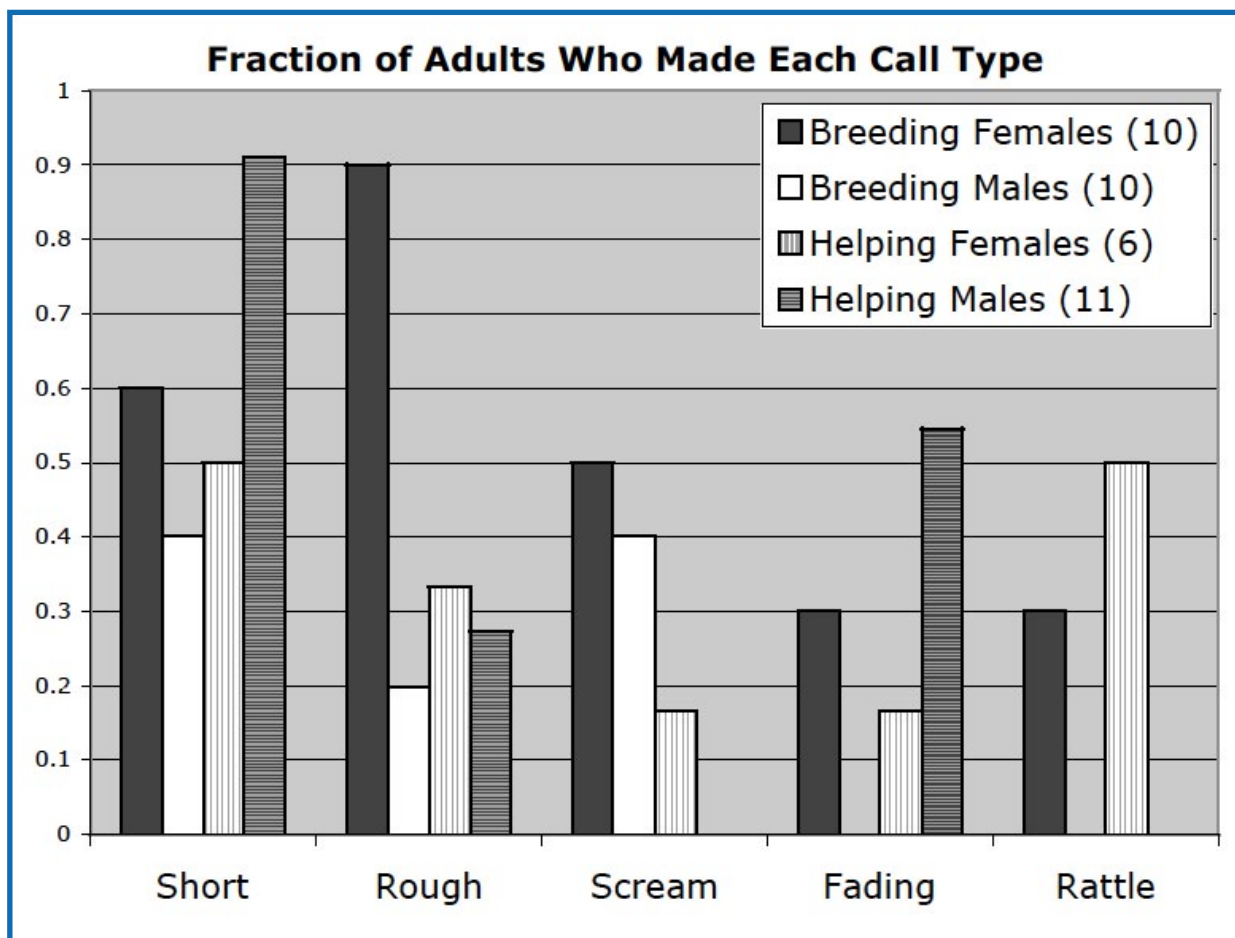
(2) Cu-loos were given singly when the paired birds were together, when alone, before copulation, or prior to egg-laying. They were given by a flying female. Breeding males gave this call when landing among their family members feeding on thrown corn. Kilham also thought crows gave this call when near him and his wife. A few times one or more crows followed him on his walks across a pasture and gave this note when he was watching.

(3) Kuck-woo-ooos were often given when bowing and had a distinctive faraway quality. They reminded Kilham of the cooing of an exotic,

tropical dove. On 2 February, when sitting by a oak in which a nest was being built, a crow was perched 5 m away and bowed when the sound was produced. Another time, a breeding male gave this sound when chasing a Gray Squirrel, *Sciurus carolinensis*. And the most continuous performance was by a crow that gave Kuck-woos for 5 minutes at 12 per minute while perched in a Cabbage Palm, *Sabal palmetto*.

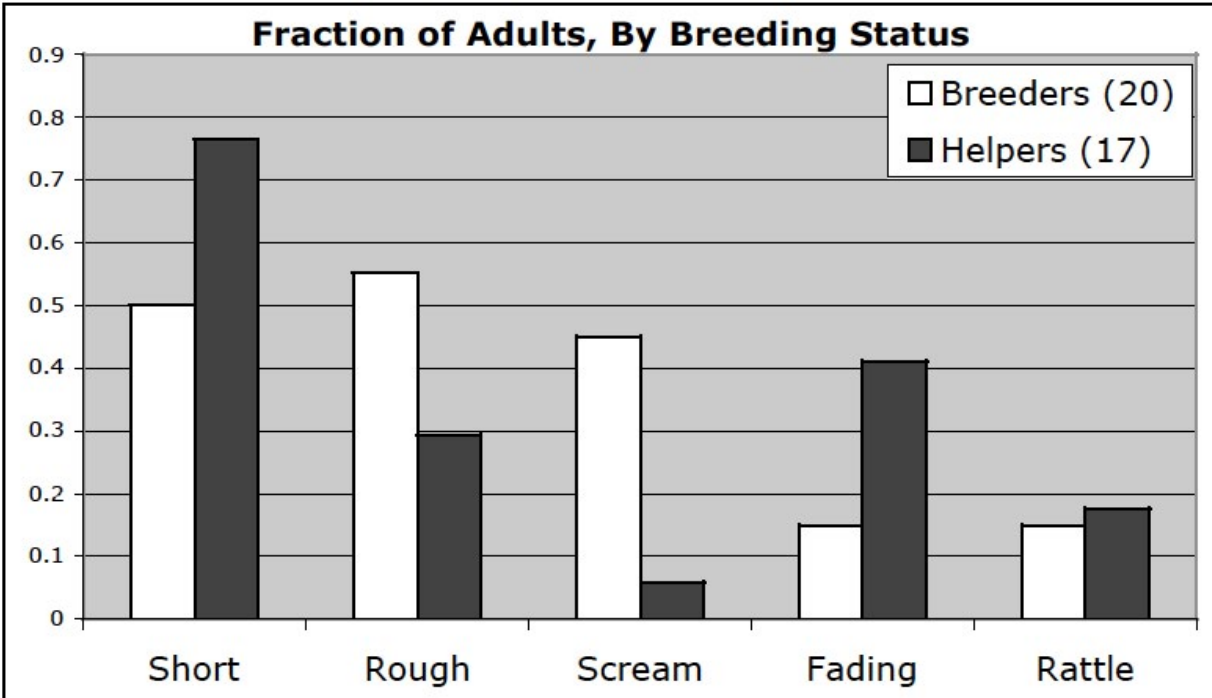
(4) Barred Owls, *Strix varia*, were imitated by American Crows that gave a Who-who-who-ah and Who-whos in **Maryland** and **Florida**. These were the only mimetic sounds Kilham heard.

(5) Singing was a mixture of the five already mentioned calls with groans, moans and varying caws at a rate of one per second. Solitary crows,



171. American Crow Breeding adult females give the rough call most often, and helping adult males the short and fading calls most often t07, © Ohio State University





172. American Crow Adult helpers gave more short and fading type calls than did the breeders t07, © Ohio State University

mostly yearlings, seemed to be practicing their entire vocal palette by singing. Older auxiliaries, isolated from the family group early in the breeding season, also engaged in this diversity of sound.

(6) Rattles were given when crows were in conflict with Red-shouldered and Red-tailed Hawks. When driven away, a lone crow that tried to join other groups made rattles.

(7) Intimate notes were a variety of soft sounds made when a pair were together on a nest well before incubation began and after nesting when it seemed courtship was being renewed.

Kilham realized these calls may sound different to other watchers, and some may have a limited range within the North American crow population. For some of the cu-koo and g-wal-op sounds, Kilham was unable to assign a precise meaning since the contexts in which they were given were also imprecise. He suggested that crows were individualistic in their vocal output, especially the yearlings k59.

At the other end of the cawing scale, a crow on 10 August 1906 uttered a “series of exceedingly melodious, soft cooing notes unlike any others in my experience” f56. “The conversational notes of a small group or family of Crows are always entertaining, and the observer is impressed with the extensiveness of their vocabulary and with the variations in their feelings” t72. Later, while camping at Ipswich **Massachusetts**, Townsend had his open lean-to set up at the base of a White Spruce which held a crow’s nest. Each morning he listened to “courtship notes” beginning about 04:30. He heard a rattle song (once given 54 times in a row), a whisper song, and soft and liquid cooing notes. He “saw a bird drop slowly down with wings tilted up at an angle of forty-five degrees, singing as he fell” t73.

At Ithaca **New York** (42° N), routine calls by families of American Crows were studied in relation to the sex, age, the behavior of the calling crow, and the responding crow from the start of June to the end of August 2006. This was the period right after fledging, when some young crows moved away from their family unit. The crows were often marked and sexed. Ten families





were in focus. There were breeders, 0–5 helpers, and 2–5 juveniles (HY) birds per family. Families were sampled from 3–20 times over 52 days in the field. The calls and behavior of the caller and other family members were recorded on their territories t07.

Since assembly calls had been studied, three other calls were examined –

- (1) the typical high amplitude, broadband, low frequency bouts of adult caws (5 categories)
- (2) non-caw adult sounds (2 categories)
- (3) the begging and babble sounds from juveniles (2 categories)

Spectrograms were made. Adult calls were named –

- (1) short & double short
- (2) rough & double rough
- (3) scream
- (4) fading
- (5) nasal

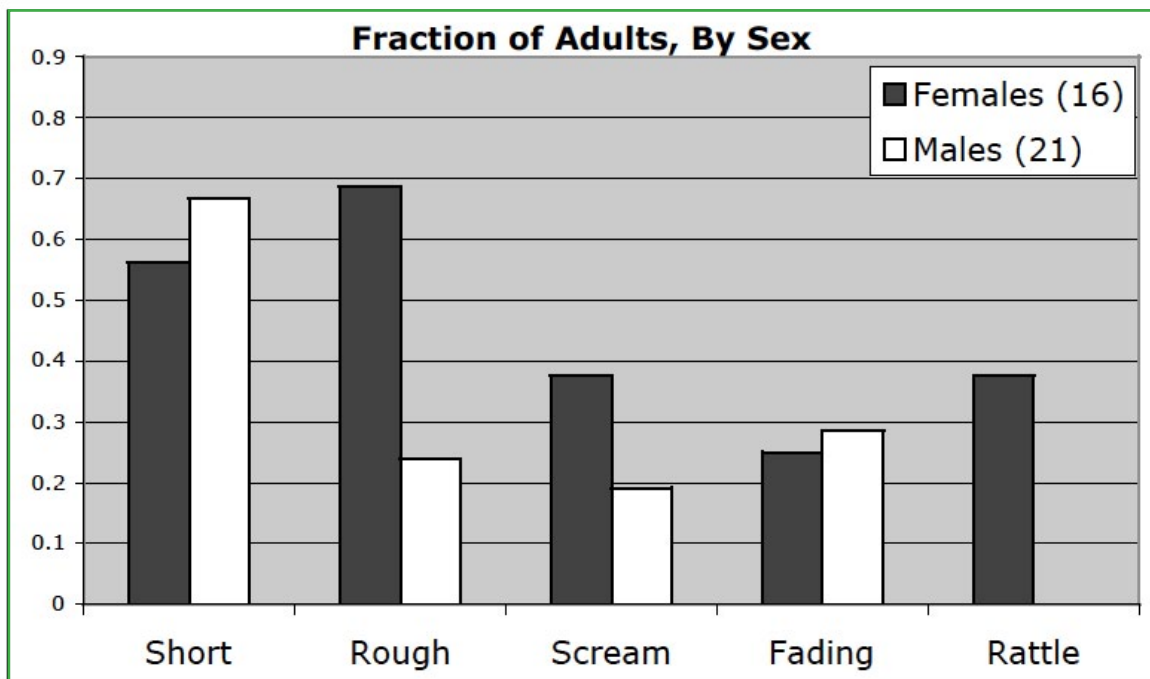
Each caw in a bout lasted from 100–500⁺ millisec-

onds (ms). Other than caws, there was a coo call lasting 100–200 ms given in bouts of 2–4 calls. Coo calls involved a visual display with the bill pointed down and into the breast. The rattle call had notes lasting between 1.5–2.5 seconds and each was a series of rapid clicks that produced a bell-like ringing sound. The conflict rattle call was rarely heard.

Although the number of recorded calls was relatively low, 5 adult calls were described –

- (1) **Short** mostly male helpers and breeding females
- (2) **Rough** mostly breeding females
- (3) **Scream** mostly breeding females and males; not by males helpers
- (4) **Fading** mostly by male helpers
- (5) **Rattle** mostly by female helpers and breeders; not by males (**Graph 173**)

Four graphs (**169, 171, 172, 173**) help to visualize the results. Helpers gave the most short and fading calls; breeders gave the most rough and scream calls. Rattle calls were evenly divided between breeders and helpers.



173. American Crow Adult females greatly outdid males in the rough, scream and rattle categories of the 5 types of calls t07, © Ohio State University

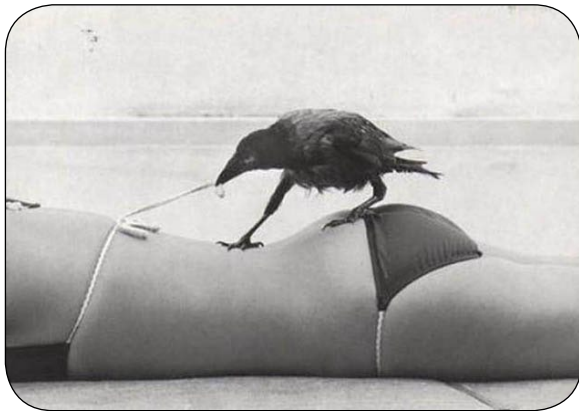




Adult birds also begged for an especially good piece of food. Begging juveniles opened their pink-lined mouths, and fluttered their extended wings to attract their parents. When a parent with food approached, the begging became louder and the calls closer together. The swallowing sound was like choked, begging sounds, which served to attract the adjacent juveniles in the family. Juveniles begged for weeks after they learned to feed themselves. A juvenile would pick up an edible or inedible bit of food, drop it in front of a parent, then beg until the parent placed the food into its mouth t07.

Juvenile begging calls lasted from 1–3 seconds and were common and loud over the summer. I have heard them, plus the swallowing sounds that follow, from about 100 m distance. Male juveniles had louder begging notes than females.

Juvenile babbling sounds began at 3–4 weeks of age and were given when separated from the family. Babbling and begging ceased at about the



If you don't hear a crow calling, it might be occupied with another job. Attached to an email; photographer & participants unknown

same age and were replaced by adult sounding calls. Generally, more juvenile males than females gave begging and babbling sounds, but the differences were not great. The contexts and results for the 8 calls –

(1) the **SHORT** call seemed to bring distant family members towards the caller. It was useful if a new plentiful source of food was located.

(2) the **ROUGH** call was given by a crow leaving the group. Also, when given at begging juveniles, the young stopped begging, or shifted their begging to another adult.

(3) the **SCREAM** call was the mobbing call of the American Crow, which is also called an assembly or harsh caw. It was given when unrelated crows, people or animals were near the nest or young. This call was given for hours when adults found a juvenile that had died from a disease, etc.

(4) the **FADING** call seemed to serve as a counter-cawing procedure between neighboring families to delineate their respective territorial boundaries.

(5) the **RATTLE** call was a short range signal of great urgency such as when a person approached a juvenile. The adult female giving the rattle was often perched nearby and stopped calling when the young were close by.

(6) the **NASAL** call's function was not clear. It was often given in flight and may signal a crow's arrival on its territory after responding to a short call.

(7) the **COO** call caused appeasement by lowering the agitation level of another crow such as a begging juvenile, or another adult.

(8) the **BABBLING** notes given by juveniles were similar to the subsong in other songbirds. They were composed of a long string with no apparent pattern. In my experience it is a long rambling bout with notes of different loudness. When heard, I liked to stop and watch a juvenile making the lengthy melody.

Regarding the use of recorded crow calls broadcast to lessen the impact of crows roosting in cities and feeding on crops, Tarter thought the calls that attracted crows to a different location from where they were, might be a more logical solution than a distress call that often served to attract more crows towards the sound t07.

In **Michigan**, CS Parr became familiar with calls from families of nesting crows. The double short caws appeared to track the seasonal changes in the frequency of territorial bouts between neighboring crows. These double short caws seemed more song-like and had a territorial function.

Breeding pairs, without helpers, responded





more acutely to taped calls of strangers than did a family of crows with one or more helpers. Perhaps the mere presence of helpers served as a deterrent to the start of a territorial dispute. Smaller territories by crows in an urban environment may favor ritualized song-like, double short caws that save energy during close encounters with adjacent families p15.

With the realization that “almost nothing is known about the mechanisms of sound production in corvids,” rattle calls were studied for 28 *Corvus* species including the Northwestern and American Crows. Rattle calls were atonal, guttural, mechanical-sounding pulsed calls given in the field by birds in pairs, in flocks, or by a single bird mobbing a bird of prey. The rattle was believed to be used in short-range communication since it was not very loud.

Five variables in the caw were measured and related to wing chord, bill length, and phylogeny. For the Northwestern versus the American Crow, the greatest variations were in –

Duration 0.48 vs 0.31 seconds

Carrying frequency 1.64 vs 10.5 kHz

Second carrying frequency 1.5 vs 0.56 kHz

Whereas similarities included –

Pulse duration 0.016 vs 0.016 seconds

Pulse rate 52.3 vs 48.1 pulses per second

Body size (wing chord length of 29.2 vs 32.5 cm respectively) helped shape the acoustic properties of the caw, but the two similar bill lengths of 4.9 vs 5.0 cm had much less effect¹⁰⁷. Do the differences further indicate these two corvids are separate species?

For Common Ravens, warning calls without harmonics only got a bird's attention, whereas calls rich in harmonics were the raven's mobbing call. Various harmonics resulted in various behavioral responses a48.

Song Sparrows produced variants of a certain song type by switching frequencies in response to taped playbacks of simulated territorial intrusions (an aggressive signal). Once the fake intrusion was over, the real song type returned to its normal level s51.

Unless one is familiar with the great assortment and mix of calls and singing by crows, the written descriptions are nearly meaningless. When you become tired of listening to Mozartian music, or musical groups with Crow in their names, tapes of some calls by American Crows are available online from the Macaulay Library, Cornell Laboratory of Ornithology at Ithaca **New York**. In *Birds of North America* online, there is a short audio tape of a cawing crow.



A breeding Common Raven displays an all black mouth as it calls from a tree 100 m from its nest

Concerning mimicry, that wonderful form of flattery, crows are known to imitate the sounds of birds, dogs, chickens and people. “Oh my god, or lord” and “hello” were clearly spoken by crows c52. Crows said words like “mamma, papa, hello, howdydo,” and imitated human laughter g75. Rooks imitated certain vocal traits of their mate to strengthen the pair bond 18r. Lawrence Kilham (pers. comm. 1987) said his pet raven not only talked, but would use his tone of voice.

Henry the crow was newsworthy. In the *Globe and Mail* of 21 February 1984, under **ONTARIO BRIEFS** appeared this humorous tale –





POLICE ASKED TO KILL HENRY FOR FOULING THE AIR

PORT COLBORNE, Ont. (Special) – Henry’s foul tongue has got him in trouble and police have been asked to shoot him. “But that will only be done if we are issued with a death warrant from the humane society.” Staff Sergeant Robert Saunder of the Niagara Regional Police said. Henry is a crow who escaped several months ago from Marineland and Game Farm, where he had been taken by his owner after becoming wild and vicious. For two weeks, he had cawed obscenities at children in school playgrounds and shoppers at a mall. Last Friday, he perched on a parked car and cursed patrons entering the Royal Canadian Legion.

The next morning a TV crew arrived to interview Henry. Alas, he could not be found. The crew talked to the local children and they mentioned that Henry could say the f-word.

Practice calls

A wonderful sound, which a dedicated crow-watcher will hear, is the juvenile song. It is defined as “non-typical, often without phrases,” and though it can be part of the adult’s repertoire in the springtime, it is also part of the developmental singing in young birds and therefore can be called a juvenile song ^{35b}. This sub-song among young birds “appears to be a form of ‘practice’ for the production of full song” ^{t50}.

The first practice calls recognizable as sub-song that I heard in the field were from a juvenile crow during the first week of June. Two nestlings, which I raised from about three weeks of age, first gave practice calls on 4 June, which was probably close to their fledging date. When these guttural practice calls are given, the head of the

THE BLACK CROW

A black old crow
Sat on a tree
And he swore at you
And he swore at me.

And the only cuss
That he knew was “Caw”;
But he cussed that cuss
With great eclat.

But another bird
Cried, “Caw-Caw” slow;
And I said: “He’s swearing”.
But a bird said: “No”.

That’s a preacher bird,
And he’s only saying
The same words slow
So they sound like praying.

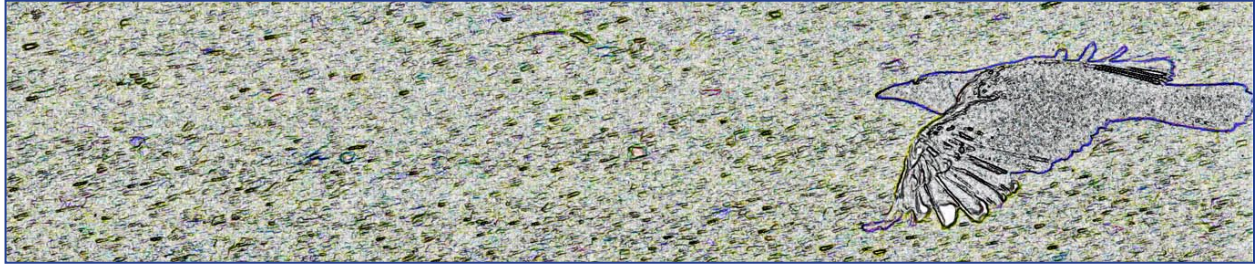
“Our words are the same
If you swear’em, or pray’em,
But it’s all in the way
The black crows say’em.”

– Wilson MacDonald 1930 m06



A cawing crow may pump its wings and fan its 12 tail feathers. The repeating formal elements and symmetry of a crow’s body are obvious. Here the left wing is over the right wing. Is this a personal but variable trait





crow reaches forward, points slightly up or down, the throat bulges and the bill is open 1 cm or less. Following its initiation, sub-song was produced each day by the captive pair until they could fly a week later. Mid-September, when the first juvenile body molt was nearly complete, was roughly the last time I heard practice calls by juvenile crows in **Guelph**. Crows about five weeks of age produced recognizable higher pitched bouts of caws, but the practice call was the most fascinating. I have heard practice calls only from a perched crow. In a group of 2–4 juveniles, usually only one bird gave the sub-song. Several flowing bouts were often repeated in a sequence lasting up to a few minutes. They can be heard up to 100 m away. A bout contains caw-like louder notes which can be counted. Greeting a July dawn came this uneven, practice call sequence: 8–21–19–2–4–5. Yearling and adult crows have their own sub-songs, but nothing comparable to that of the juvenile's. Carolee Caffrey heard juveniles give their first caw-like calls at 4–5 weeks of age ^{v18}.

The learning of any vocabulary is a compli-

cated procedure relying on imitation and innate processes. Among sparrows, juncos and black-birds, “It is hard to imagine the production of vocal imitation without some degree of prior experimentation, at least in early stages of development of the skill” ^{m37}. Taken a step further, there are similarities between a human infant's first babbles and a juvenile bird's sub-song, each of which are precursors to a full working species specific vocabulary ^{m36}. Hand-reared mimetic starlings learn only those sounds given in conjunction with the social interaction by their caretakers ^{w55}. It may be fruitful to investigate the relationships between “human social modeling theory with its emphasis on live, interacting tutors” and vocal learning among birds in order to develop a framework for understanding both of them ^{p38}.

In the learning process, there is a strong possibility that local dialects are developed in some populations. Common Ravens in **Virginia, Alaska** and **Germany** shared many, but not all of their calls ^{08c}. South of Bern **Switzerland** (47° N), among vocalizations of free-ranging breed-





ing pairs of Common Ravens, there was a mean of 12 call types per individual with no difference between the sexes. An average of about 20% (0–77%) of their calls were shared by any two birds in the population. About 80% of the calls of a raven were similar to calls used by other ravens. Cultural transmission through vocalizations (40%) took place within a sex, and only 10% between pair partners. This produced a strong sexual dimorphism in their vocal output e44.

Parent American Crows and their offspring probably recognize each other vocally. I make this suggestion based on common sense. Experimentally, using 18 statistical parameters, McArthur determined the “begging calls of Pinon Jay nestlings and fledglings are extremely complex, individualistic signals,” and by the time of fledging, the parents and young jays have mutual recognition. An individual variation of about 20% was measured in the begging calls, and since these calls changed as the young aged, the parent must adjust to these subtle alterations. As with any study of this kind, McArthur realized that statistical significance must be matched with biological significance before any solid conclusions were possible m66.

Can adult American Crows recognize each other? Duet notes were given to establish recognition between two isolated males and between pairs of crows at a roost c52. It certainly seems possible that each crow of a mated pair can recognize the other by either a specific call or, as suggested for the Pinon Jay, vocal idiosyncrasies of each bird b93.



Vocal experiments

North American calls

Two calls of the American Crow are of special interest. The assembly call is a loud, unstructured grainy call of long caws produced when a crow sees a predator. American and Fish Crows assembled to this call to mob a predator c52. A crow may be perched or flying when giving this call. To determine what there was about the assembly call that American Crows found attractive, taped natural assembly calls had their properties altered. From four experiments, they found “the most effective call for assembling crows appears to be a grainy call of high temporal density [short inter-caw intervals] which is accelerated, ie, arranged in cycles of increased density” r51.

Natural assembly calls were broadcast from an automobile in **Maryland** in the spring of 1969. The broadcast, almost 6 minutes long, was repeated 14 times, and a manufactured tape of a single repeating average call (caw) was played 11 times. The broadcast range was 94 m in all directions. American Crows assembled to both broadcast types in 8 of 25 (32%) trials. A total of 19 crows appeared in the 8 positive trials.

However, in one or more of the assembly call broadcasts, 8 other bird species, including a Broad-winged Hawk, *Buteo platypterus*, responded positively and often emitted combative sounds. Once each, a Blue Jay and a Common Grackle mobbed the few crows that assembled. Since other birds responded to the broadcast assembly call of the crow, was it logical to label the call species-specific? It was believed the other bird species





A Chipping Sparrow is a distinctive singer

arrived with the intention of mobbing the crows on the taped calls c51. I have watched about 12 crows respond to mobbing calls, from over one km distance in the country, by a pair of crows when their nest was attacked by a predator. How many of the dozen crows which came to assist were related? In an urban environment, where crows maintain a small territory, an alarm call by one of the parents would alert not only its immediate family to a danger, but would alert several neighboring crows on their territories.

The second sound, the unstructured dispersal call of the American Crow, was a bout of sharper, louder caws given when extreme danger was noticed ie, a hunter. When given, crows usually flew from the area, but sometimes crows assembled to look for the reason c52.

The evolution of the dispersal or alarm call presents some interesting behavioral questions. Briefly, the model scene occurred when a sentry crow, usually perched atop a tree or other high location, gave an alarm call when a hawk ap-

proached a feeding flock of crows. In doing so, did the sentry increase its chance of survival? The makeup of the flock, such as the number of the sentry's kin present, the number, age, and sex of the birds, and the number of species involved should be known when the behavior of the sentry was analyzed. A sentry giving the alarm call might benefit by saving those who receive his / her signal because they would be retained and stayed in the sentry's area, kin relationships aside 01s.

American and European calls

In the mid-1950s, an international investigation involving French and American scientists developed f75. Here is their story. In **Maine** and **Pennsylvania**, the assembly and alarm calls of the American Crow were played. American Crows came to the assembly call about 90% of the time in groups of 5–200 birds. The crows exhibited a fleeing action when their alarm call was played.

In **France**, three species of the genus *Corvus* intermingled overwinter in roosts and during feeding – the Jackdaw, Rook and Carrion Crow. The Jackdaw, of Konrad Lorenz fame, emitted a distress call when held by the legs or in the clutches of a falcon. When this distress / alarm call was broadcast near feeding flocks, the birds generally approached, circled, then disappeared, or they dispersed directly. At roosts near Paris, the Jackdaw's distress call was played for a few minutes. All three species rose in the night and abandoned their roosts for 3–30 nights 3b4.

With the home tests finished, it was time for the two scientific groups to exchange tapes. In the **United States**, on a summer's day in Maine, the Jackdaw's distress call had no effect on local American Crows. However, at Pennsylvania in the summer, crows moved towards the Jackdaw's distress / alarm sound as they did to their own assembly call. On a winter's day in Pennsylvania, there was no reaction to the same distress call. Together, we have the equation: summer Maine crows = winter Pennsylvania crows in their lack of response to the Jackdaw's distress call. A reason was suggested. Looking at the annual cycle of the birds, relationships emerged. With the approach of winter, Maine crows migrated south into the New England area and into Pennsylvania. Meanwhile, crows in Pennsylvania migrated south



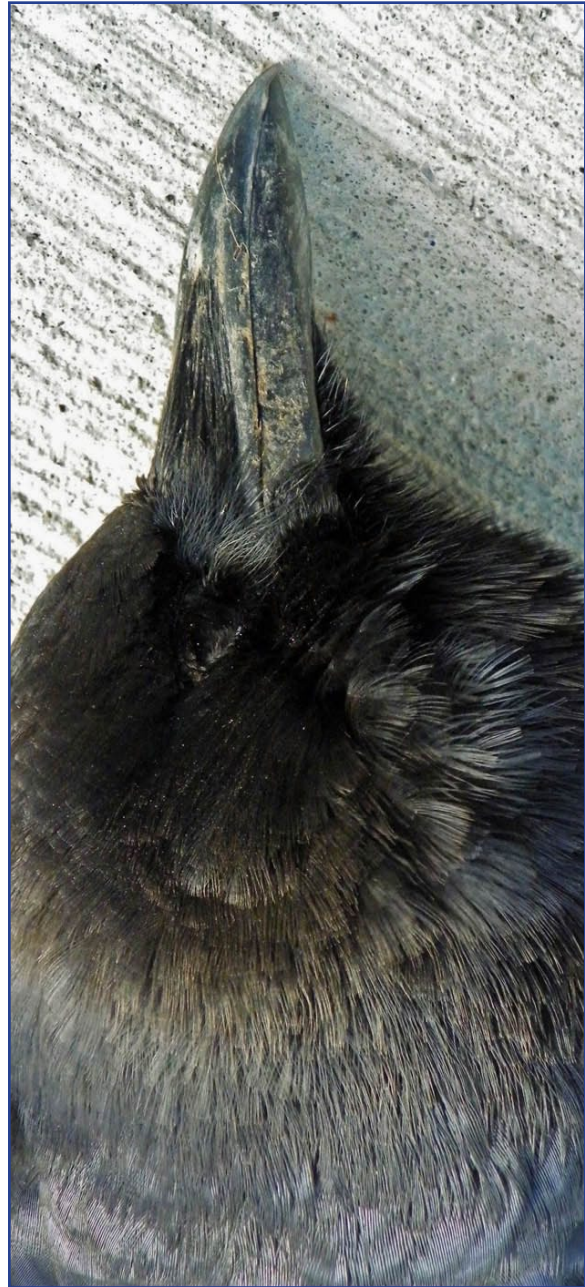


where they came into contact with the Fish Crow, a smaller species with a voice resembling the Jackdaw's. American Crows learned to react to the call of the Fish Crow. In spring they returned to Pennsylvania and nested over the summer. When they heard the distress call of the Jackdaw in the summer, they reacted due to their more plastic behavior developed by associating with the Fish Crow on their wintering grounds. The Maine crows never contacted another Corvid species throughout the year. Consequently, they did not learn to react to the calls of another Corvid. And so, wherever Maine crows were, in Maine or Pennsylvania, there was no reaction to the Jackdaw's distress call.

In winter in Paris **France**, the alarm call of the American Crow had no effect on the resident French corvids, but its assembly call worked on the three species. At first the birds approached the sound, then dispersed. This was the way they reacted to the distress call from the familiar Jackdaw. Its semantic value (meaning) was understood by the crows in France. Whether or not this vocal difference applies to American Crows exposed to alarm calls from crows in France remains to be studied ^{3b4}.

for those of you that identify your birds by sound, keep in mind the imitative capabilities of American Crows. They often gave a guttural croaking call, unlike their usual caw, which was close to that of a Common Raven. As a result, many of the Common Raven reports from southern **Minnesota** may actually have been American Crows ^{e10}. Personally, I have never heard a visible crow giving calls that sounded Ravenesque.

Let's move far away from American Crows. In **Spain** and **Portugal**, the song of migratory and sedentary Blackcaps, *Sylvia atricapilla*, indicated "that migratory Blackcaps are under stronger sexual selection pressure due to female choice, and suggest that sedentary Blackcaps were under strongest selection pressure due to male-male competition, as shown by differences in song characteristics" ^{01c}. Crows in cities are mainly sedentary and maintain year-round territories. While migratory crows generally occupy rural areas, their vocal differences may be as pronounced as those of Blackcaps in Spain.



Dawn chorus

In a more practical sense, vocalizations of the dawn chorus by American Crows have been studied by a few observers. A good question at this point in the discussion is, why do crows and other birds sing at dawn? Some researchers decided the function of the dawn song was part of the territorial defence mechanism against potential invaders who may have accumulated overnight.





At dawn, weather conditions such as low wind favor vocal communication, and low light intensities hinder foraging efficiency, so the birds may as well be singing k02.

When American Crows began their day by singing, probably for the above reasons, I could usually detect the first ambient light. It was near civil twilight or about 30 minutes before sunrise. With more detail, the average time of the first bout of caws was 22 minutes before sunrise for 40 mornings in **Guelph**. When stars were visible, crows started calling earlier, about 27 minutes (8 before in February to 36 before in July) before sunrise. A cloudy sky, occasionally accompanied by rain or snow, caused the crows to hold their first calls until 17 minutes (2 minutes after in February to 28 before in July) prior to sunrise.

Surrounded by a gray dawn near a nest while listening for the calls of distant crows, the timing of initial calls from different directions occupied a period of about 10 minutes. I could not know the status of crows calling in the distance – were they other nesting pairs, non-breeders, floaters, or even if crows not associated with a territory / nest engaged in a regular dawn chorus.

Feeling the need, Fisler listened to birds calling at dawn in a deciduous woodlot in southern **Michigan**. Defining the awakening time for crows as “when more than one bird has begun to sing continuously,” he organized his year’s work into a little table, part of which is reproduced below. For the crow, the average was about 20 (16–26) minutes before sunup.

Period	Crows awoke (called)
7 Mar.–30 April	26 minutes before sunrise
1 May–31 July	18 minutes before sunrise
1 Aug.–30 Nov.	19 minutes before sunrise
1 Dec.–6 March	16 minutes before sunrise

He explained the timing of the dawn chorus. At the summer solstice on 21 June, the longest day, crows did not call the earliest. Instead, they did so in the spring period of 7 March – 30 April, when they were under the most stress from territorial encounters and breeding. In the spring they began their days early, especially if the sky was clear f35.

From my limited exposure to the dawn chorus in **Guelph**, there did not appear to be a standard routine of calling. One bird of the pair broke the silence; then the mate may join in. The length of the first sequence of bouts, and the number of caws per bout varied almost daily. Listening to one family of crows on 11 September, a cloudy morning, a sequence of 14, 2-caw (2–2–2–2) bouts was delivered by one bird before the pair flew from their roost and began feeding. Later in the year, with a light February snow caressing their feathers, I listened to a broken sequence of variable caws: 3–9–17–3–14–5 from the same pair of birds over six minutes prior to leaving their roost. Finally, in July during a warm rain, two bouts of 5- and 2-caws reached me before the family departed to feed at their favorite area of lawn. When juvenile crows first begin to call in the morning is unknown. In the White Mountains of **New Hampshire**, a list was made on the order of the first morning calls of all bird species. The crow placed 25th, well behind the earliest calling species in the fresh light of dawn 45w.



A review of the dawn chorus and early feeding behavior used a theoretical model of the increasing level of light in the morning in relation to timing and duration of singing, and the shift to feeding behavior 71h. I have watched a family of crows withhold their dawn chorus and leave their





overnight roost. They flew to an often used area of lawn next to a parking lot to begin feeding under the glare of a yellowish street light. As objects regained their coloration in the morning's natural light, the crows simply expanded the area of lawn they fed in, beyond the coverage provided by the powerful street light. I doubt if the blackshirts fed at their full efficiency under the street light, but it was a beginning to the natural flow of the day.

Another theory dealt with singing at dawn because feeding at this time had less benefit. Birds have all day to regain energy from feeding to survive the next night. There was no rush to get going in the morning, so they may as well sing. However, there may be a switchpoint in their behavior when singing in the morning stopped and the time / urge to feed began, based on dwindling energy reserves related to the overnight weather. [For a large bird like the American Crow, this is usually not applicable.] Finally, other explanations and potential solutions were given as to why birds sang at dawn 07m.

In **Denmark**, considering all the territorial implications for Hooded Crows that participated in the dawn chorus, it was concluded "Hooded Crows are well suited for long distance communication and that they may also to some degree be specially adapted for it" j24. ■

